

***I*Create: preliminary usability testing of apps for the music technology classroom**

Teaching and Learning Forum
2015

Category: Research

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In the world of music technology where, “music practice is challenged, mediated and redefined through performers’ and composers’ uses of ICT” (Savage, 2005, p. 168), curriculum change is necessary if the world of the classroom is to keep pace with the world outside (Cain, 2004, p. 219). For newcomers to music technology, the glittering array of increasingly sophisticated flashing, emulated, and modulated interfaces can invoke virtual interface dyslexia before giving way to options anxiety. Change is the only constant in the ever-evolving techno-scape of sound and music applications. This paper proposes that the development of an introductory tertiary music technology unit curriculum using loop-based music *iPad* apps may effectively engage non-traditional music students in both music and technology. The course design was underpinned by two intentions. Firstly, the aim was to stimulate student creativity and secondly, to encourage *immersion* (focused attention) in sonic composition (Witmer & Singer, 1998). This paper reports on the preliminary usability testing of five loop-based music *iPad* applications. It is administered to a sample of one, namely the author, using the *System Usability Scale* (SUS) (Brooke, 1996) and is guided by the following questions: Would this testing methodology be appropriate? What factors specific to loop-based music app design might be pertinent for educators? Would this testing method indicate the potential for student immersion and creativity? While the pilot study, described here, is conducted solely by the researcher to determine the effectiveness of the method, future research intends the study to be administered to a small classroom group if determined appropriate.

Introduction

Jay Dorfman believes that smart phones and tablet devices “will revolutionize our work in technology-based music instruction” (2013, p. 188). Arguably, such devices are the next step in music pedagogy. Some have suggested that the emergence of the *iPad* in the music technology landscape will democratise music making further in the same way that the emergence of digital cameras made photography and filmmaking available to anyone (Tough, 2009, p. 4). There are some distinct advantages to tablet devices, being relatively cheap compared to laptops, they are smaller, more portable, software updates are usually free and touch screen interfaces are simple to use. The culture of app development is also moving the technology forward quickly and there is still a lot of novelty attached to tablets as music production devices. These are strong reasons why students may find engaging with tablets a fun and creative experience (Dorfman, 2013, pp. 190-191).

However, in comparison, to existing Windows, Apple or other PC/desktop audio applications, the *iPad* is a new technological environment for music production. The *iPad*’s lack of maturity will present challenges for educators but these may be mediated by the benefits arising from the novelty, portability and a sense of ownership/intimacy of the device itself (Goodwin, 2012, p. 22). Preliminary research points towards the notion of “embeddedness” where the tablet device becomes a part of the student’s daily cerebral processes as a tool to resolve problems, socialise with the world, and perform common productivity tasks (Puentedura, 2011). Early thoughts also cite the *iPad* as a “curiosity amplifier” (Brown, 2010). These factors may motivate creative learning via music technology on the *iPad* and there is support for this belief.

Teachers believed that optimal use of *iPads* was attained when students used content-creation ‘productivity’ apps as this developed higher order thinking skills and provided creative and individualised opportunities to express their understanding (Goodwin, 2012, p. 8).

In light of Goodwin's observation, this paper presents the preliminary usability tests of five content-creation loop-based music technology *iPad* apps, prior to trialling in the classroom. The testing has been undertaken with the guiding intentions of provoking student creativity and secondly, encouraging *immersion* (focused attention) (Witmer & Singer, 1998) in sonic composition in the classroom.

Creativity

ICreate in the title of this paper was chosen to emphasise the importance this author has attached to creativity. The word should be read as 'I create' (where 'I' is a student). Our role as teachers is surely to cultivate our students' creative disposition. Delmege and O'Mahony (2013) argue that cultivating a creative environment where university teachers "explicitly embed creativity in curricula in a purposive way" will play a significant role in developing a "high functioning approach to learning" (ibid, p. 246). From this perspective, creativity is central to learning outcomes and musical composition is one form of curricular creativity.

Can usability studies of *iPad* music-production apps aid in this curricular pursuit of creativity? Is there a relationship between creativity and app usability? This paper suggests that technology that is 'fit-for-purpose' is an important factor in the learning and creativity process. A look at the three broadly defined components of usability may help illuminate this suggestion:

- Effectiveness (whether people can actually complete their tasks and achieve their goals)
- Efficiency (the extent to which they expend resource in achieving their goals)
- Satisfaction (the level of comfort they experience in achieving those goals) (Brooke, 2013, p. 32)

These components of usability can be mapped to existing notions of curricular value for musical composition, suggesting a strong synergy between usability and creativity. For example, composing can be seen as a problem solving activity. When a composer accepts a commission, there are structural parameters that must be included within the work, such as musical style, duration, possible picture synchronisation, mood and likely destination. The needs of a compositional brief outlines the problem. The composition should both solve the problem and be an aesthetically pleasing artefact (Watson, 2011, p. 513). If the users can complete their musical tasks and solve their musical composition goals using an appropriate app 'fit-for-purpose', this would indicate the first component of technology usability, *effectiveness*, has been achieved.

The value of creating also has a positive effect on the creator. Michele Kaschub and Janie Smith believe that, "creating music where none previously existed is a powerful act of self" (Kaschub & Smith, 2009, p. 105). Students gain comfort and confidence in organising notes, rhythms and melodic phrases, strengthening their sense of self and often powering their new found musical talents to greater creative sophistication. If students are able to organise musical components with ease, using an appropriate app, this would indicate the second component of technology usability, *efficiency*, has been achieved.

Watson believes that technology can unlock musical creativity in any student where, "Every student is both blessed and limited by their musical experience" (Watson, 2011). Technology comes to the aid of those non-traditional music students, potentially enabling more effective expression. Non-traditional music students thrive in elective music courses that emphasise creativity and technology (ibid, p. 983). There is a possible assumption here that technology is somehow a "magic bullet". However, the idea points to Brooke's third component of usability. If students feel *satisfaction*, a level of comfort about the process of achieving their musical goals, using an appropriate app, it would indicate the third component of technology usability, *satisfaction*, has been achieved.

By a similar token, "Composers often view the music they have created with a sense of ownership or custody" (Watson, 2011, p. 677), and for students this is the development of self. This cultivation of the self encourages our students to practise what Delmege and O'Mahony (2013, p. 246) describe as "the most complex cognitive process" and the development of higher order thinking skills. There may be a sense of indirect *satisfaction* derived here as well.

The technologies being tested in this paper are important because they are one potential entry portal to musical creativity. The usability of apps has the potential to encourage creative expression or, at worst, create barriers to creativity. If apps are *effective*, *efficient* and *satisfying* (Brooke, 2013, p. 32) to use, it would suggest that the usability of technology has an impact on learning and creativity stimulation. This highlights the importance of the preliminary usability testing of apps prior to integration into any teaching and learning environment.

Immersion

The notions of *usability* and *immersion* have been studied most visibly in the world of mobile gaming and the related field of human-computer interaction (HCI) (Hung, Chou, & Ding, 2012, p. 45), however this paper suggests there are parallels with music technology content-creation apps. The degree to which a technology keeps a user involved has a bearing on learning.

Immersion is characterised by gaming researchers as an interface that is able to isolate users from outside stimuli to the point where users have the sensation they are within the gaming environment and interacting with that environment in a normal manner (Tamborini & Skalski, 2006, p. 229). Immersion is usually described as an important aspect of the *flow* experience associated with artistic creation, performance, video game playing and sports; where people enjoy a “distorted sense of time, loss of self-awareness, and a feeling of transcendence and complete immersion” Csikszentmihalyi (1990) articulated immersion as an essential element of the flow state and this has been adopted by gaming researchers as one measure of success of a game. Consequently, usability and immersion have been studied as closely related measures of mobile gaming user-satisfaction (Hung et al., 2012).

Similar usability methodology has previously been applied to iPad apps (Budi & Nielsen, 2010). Immersion will be a consideration during testing of music tech apps. If an app can be an immersive during preliminary testing, the potential for student immersion is a possibility.

Loop-based composing

The historical challenge for music educators has been to engage students on their own musical terms, rather than those rooted in the classical musical canon (Sloboda, 2001, p. 243). Students are immersed in their own musical and sound cultures (Ruthman, 2007, p. 38). Loop-based software can help non-traditional music students to express their musical ideas in a meaningful composition experience. Students can choose musical loop elements from their own musical world. They can compose by engaging with notions of texture, form, mood and affect (ibid, p. 41) without prior traditional musical experience. Bill Crow, similarly, believes that organising and choosing loop elements is ideal for engaging students with rhythmic structures, sound timbres, the roles of instruments within ensembles, the emotive qualities of sound and its arrangement (2006, p. 125).

Loop-based composition is also praised by Crow (2006) for social reasons after his work with diverse ethnic communities in London. His experiences suggest that for music teachers working with multicultural students, loop-based music technology can empower ethnic minorities to express their own musical identities: “the ability of these musical tools to cross boundaries within the context of authentic musical expression should be recognised” (Crow, 2006, p. 126). Cultural music predilections can be addressed effectively with loop-based technology.

While loop-based apps tend to be easy to learn and fun to use for students, their inherent ease modifies the role of the teacher significantly. There is a responsibility to select apps that are appropriate for learning outcomes. The usability of apps is the starting point for this paper.

Usability

There are no quality assurances or evaluative mechanisms to guide the educational community in the choice of apps, let alone music technology in a tertiary context. The most fruitful field is the *evaluation* of tablet technology in medical education (Jonas-Dwyer, Clark, Celenza, & Siddiqui, 2012;

Perez, Isenburg, Yu, Tuttle, & Adams, 2013). There are concerns about the proliferation of tablet technologies that are ‘fit for purpose’. Educators at the University of Western Australia found that 82% of medical students accessed the Internet from their hand held devices (*iPhone*, *iPad*, PDA etc.) during their studies (Jonaz-Dwyer, Celeza, & Leece, 2011). At Stanford University *iPads* were provided to medical students by the school (White, 2010) for use during their studies and at the University of Adelaide, *iPads* are being trialled as replacement text books in the faculty of science (Cross, 2010). Ellaway suggested that particularly in the case of medical studies, “apps could be life-saving or lethal” (Ellaway, 2011).

IPad usability has been overlooked with the exception of two studies from the Nielsen Norman Group (Nielsen, 2010, 2011). Their conclusions in 2010 state that “*iPad* apps are inconsistent and have low feature discoverability, with frequent user errors due to accidental gestures. An overly strong print metaphor and weird interaction styles cause further usability problems.” A year later, usability was revisited by the same author and they concluded that, “*iPad* apps are much improved, but new usability problems have emerged, such as swipe ambiguity and navigation overload”. Neither of these studies paints a great picture of usability for the *iPad*. Tablet technology developers have been rushing to develop gestural or ‘natural interfaces’, at the expense of well-tested standards of interaction design (Norman, 2010). As the study author stated, “The first crop of *iPad* apps revived memories of Web design from 1993... graphic designers went wild, anything they could draw could be a UI (user-interface), whether it made sense or not. It’s the same with *iPad* apps... There are no standards or expectations” (Nielsen, 2010). Experimentation in the public arena, at the expense of established HCI guidelines, is the reason why so many apps fail to survive (Norman & Nielsen, 2010).

With this muddled tablet HCI in mind, this study sought an established usability testing model that could be used with iPad apps. One of the most tested and well regarded usability models is the System Usability Scale (SUS) (Brooke, 1996). HCI experts who tested the SUS over a ten year period with 206 usability tests with a wide range of interface types found it highly reliable (Bangor, Kortum, & Miller, 2008). Similarly, Tullis and Stetson (2004) tested websites using five different types of usability surveys and found the SUS the most reliable across the different samples. The SUS will be used in this paper.

Methods: Preliminary usability testing

The testing would be undertaken by the curriculum designer before entering the classroom administered to a sample of one, namely the author. Prior to the selection of an app for testing, a suitability process was conducted to reduce the scope of the field. With over 7000 music apps available at the time of writing (Jenkins, 2013, p. 83), this was a necessary step. The objective was to source apps that potentially could be used in the classroom as loop-based composition apps. The case study process began at this point. The selection of cases needed to maximise what could be learnt, in terms of usability, illuminate the research questions and ensure the cases were easy to test (Stake, 1995, p. 4; Yin, 2009, p. 26). This process in case study research has also been termed “purposive” or “judgemental” sampling (Neuman, 1997, p. 206). The expert aims to ensure the inclusion of particular types of apps which will assist in providing a deeper and representative understanding of the type of app available.

With these case study objectives in mind, the researcher consulted documentation such as online reviews, the *Apple App Store* product pages and app developer’s websites, prior to testing the app. Loop-based composition apps come in a variety of guises; some are designed with a more traditional digital audio workstation (DAW) interface and functionality, others are developed by and probably for electronic dance music (EDM) DJs, those emulating analogue technologies, and also there are those that have embraced innovative graphical user interfaces (GUI). These main types emerged during the case selection stage of the research.

The author narrowed the testable apps to five. *Cubasis* represented a traditional DAW recording interface with wide-ranging functionality. *Studio.HD* also represented a traditional DAW recording interface but with limited functionality and a more simplistic interface. *IMPC* represented an

emulation of an analogue sampler and sequencer interface from the late 1980's. *Looptastic HD* represented an EDM DJ-friendly, performance-based sample player and sequencer. *Loopy HD* represented a performance app with an innovative graphical user interface.

It should be noted that these case studies are ethnographic in nature, and they depend to some degree on the personal filter of "selective perceptions" (Patton, 1990, p. 204) of the researcher. In this study, the researcher's selective perceptions are brought to bear in two different ways; firstly from a knowledgeable industry/educational perspective, and secondly, from an *iPad* novice's perspective. The author has experience of music technology as a practitioner and educator and these skills are important in evaluating app functionality and integration into the classroom. What the author lacked, however, was any experience with an *iPad* and associated music technology. Interestingly, it can be argued that this was the best approach. Ethnographic scholars have stated that the researcher must enter the world under study, immersing themselves in the day-to-day challenges, issues and activities. The observation and participation of ethnography can be seen as "hanging out" (Machin, 2002, p. 13) with the apps being tested. In essence, the tester would be faced with many of the same experiences that a student in the classroom could expect when confronted with a new *iPad* app. This duality of knowledge and little knowledge perspectives were ideal for usability testing and mediated the selective lens of the researcher to some degree.

The system usability scale: A "quick and dirty" usability scale

John Brooke believes there are "no absolute measures of usability", but broad measures of usability are vital (Brooke, 1996, p. 189). In his words, there is a need for a "quick and dirty" usability scale which offers low cost evaluations of any system. John Brooke is known for developing the *System Usability Scale* (SUS) which has been described as "an inexpensive, yet effective tool for assessing the usability of a product, including Web sites, cell phones, interactive voice response systems, TV applications, and more" (Bangor, Kortum, & Miller, 2009, p. 114). Typically, the SUS has been applied to electronic devices where human-computer interaction occurs.

The SUS borrows the general measures of usability as prescribed in ISO 9241-11 (ISO, 1998), addressing global conditions of subjective usability. ISO (International Organisation for Standardization) is the world's largest developer of voluntary International Standards. ISO 9241-11 is a standard covering the ergonomics of human-computer interaction, specifically dealing with effectiveness (task completion by users), efficiency (task in time), and satisfaction (user experience). According to Brooke, these measures should address:

- Effectiveness (the ability of users to complete tasks using the system, and the quality of the output of those tasks).
- Efficiency (the level of resource consumed in performing tasks).
- Satisfaction (the user's subjective reaction to using the system).

The questions are based around the use of a Likert scale. Questionnaires ask respondents to express their strength of agreement with a number of presented statements. The scale typically ranges from "strongly disagree" to "strongly agree" (Likert, 1932).

The system usability scale questions

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

Brooke suggests the best technique is to use extreme statements and ask respondents to indicate their strength of agreement on a scale of 1 (strongly disagree) to 5 (strongly agree) (see Figure 1 results below). Apps would be assessed by the curriculum designer on their usability over a two month period.

Results

Results are based on one respondent, the author, and are displayed in two ways. First, as comparative questions: Figure 1 shows how each app fared across the individual SUS questions. The comparative question results allow a snapshot of app usability by question. For example; *Studio HD* in question 7, is shown to be the app that could be learnt very quickly compared to *Cubasis* which was not considered a quickly learnt app. Second, the results are viewed as overall score results. These scores are collations of all of the question responses to form a general usability score for each app (SUS General Usability Score Results). The full SUS scoring and general usability calculation methods are available in Appendix 1.

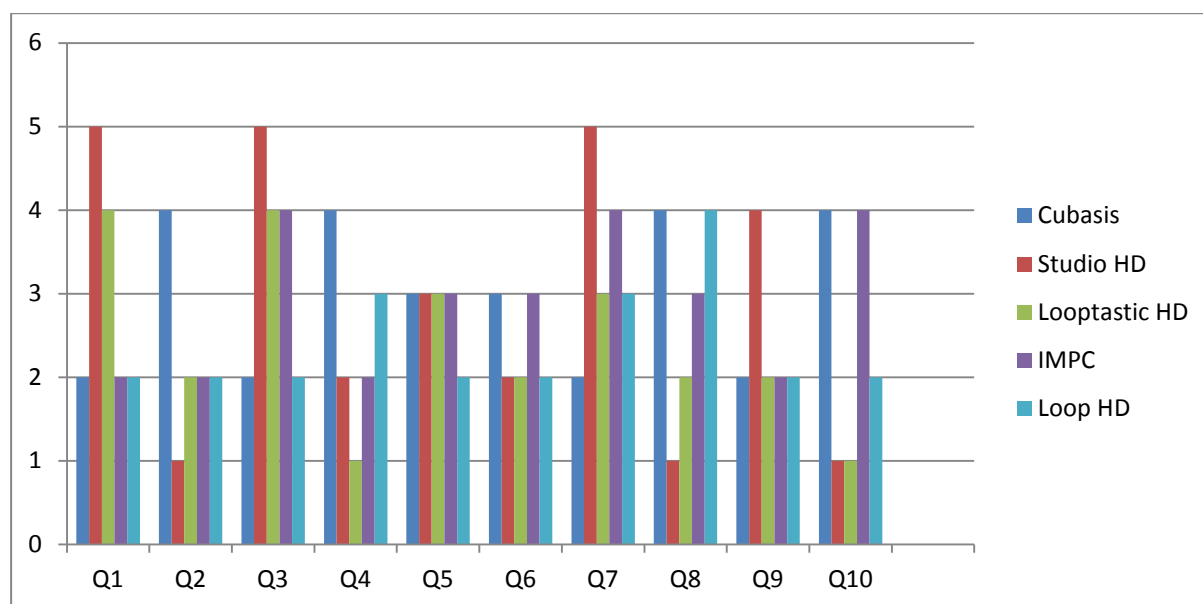


Figure 1: SUS: Comparative question results

SUS general usability score results

Each app was given a SUS score out of 100 and is accompanied by ethnographic testing notes. The SUS scoring calculations are available in Appendix 1.

Cubasis: SUS Score: 30/100

Cubasis is the *iPad* 'lite' version of the professional DAW available for the desktop. The *iPad* interface is a little clunky and interface navigation issues mean it is easy to make mistakes, something previously noted by Abi Grogan (2011, p. 35). There is high functionality packed into the interface as it offers the user access to MIDI and audio loops. Some prior knowledge of music technology is required to get the most out of *Cubasis*. For the *iPad* novice this app requires persistence to develop the skill and confidence as a user. On the plus side, the extra 'inter-app' functionality allows *Cubasis* to be a central hub for other apps. *Cubasis* can comfortably record MIDI and audio information from other apps and also copy and paste information between itself and other apps. While it has the flexibility of its PC DAW legacy, I hesitate to recommend this as an app that will inspire creativity and immersion in loop-based composition for the music technology novice.

Loopy HD: SUS Score: 45/100

Loopy HD has the most innovative GUI of all the apps. It replaces the traditional DAW interface with twelve rotating "can-tops" in a four by three square matrix, with each "can-top" representing an audio

loop. It has a gestural quality that is seductive at first use. However, creative results took time to achieve, especially when accessing multi-function file manager tab dialogue. Some function icons are ambiguous. Although aesthetically pleasing, the dialog navigation can be clumsy and take time to master. *Loopy HD* is one of the more effective and pleasing of the new breed of GUIs. It may encourage creativity and immersion for the music technology novice at first use, primarily because of the GUI but there are management elements of the app that testing found to be lacking. For example, file management of loops was hidden under several icon presses and loops did not automatically assume a natural start point comparative to other loops. The time-stretching functionality was also weak.

IMPC: SUS Score: 52.5/100

IMPC is an *iPad* emulation of the popular analogue 1980s *Akai* sampler, a “classic of hip-hop production” (Kell & Wanderley, 2013). This is an app that blends a drum machine, sequencer and DJ’s sampler player. Loops are the stock and trade of this app but the retro analogue-style user interface may be a challenge for “digital natives” (Prensky, 2001). It asks the user to imagine what is going behind the scenes, rather than showing sequenced waveforms, available from modern GUIs. For those with a DJ’s mindset this app has potential as a sample player and scope as a loop ideas generator, especially for hip-hop producers. However, for general loop-based composition, the lack of audio tempo quantising is likely to reduce the user satisfaction. The ability to time stretch audio loops of different tempos to match each other is an important function for loop-based composition and is taken for granted as an included function (Walden, 2007). In the 1980s this kind of technology was not available and thus presumably the reason for the exclusion on the IMPC app.

Looptastic HD: SUS Score: 70/100

Looptastic HD has interface design elements reminiscent of popular EDM DJ software such as *Traktor* (Native Instruments, undated) with one important difference; the user interacts/performs with primarily short audio loops rather than finished music tracks. This app crosses the boundary between the performance-style DJ approach to loop-based EDM composition and the midi/audio sequencing functionality found in DAWs. The interface is simple to look at, even aesthetically primitive, but testing found a pleasing gestural and kinaesthetic quality which encouraged immersion when using the app. The GUI is effective. This app allows the user to record all actions and create loop-based performances which are partially editable in an ‘overdub’ fashion. Overdubbing is the process of adding sound to a previously recorded performance after the main performance has been captured. (Huber & Runstein, 1995, p. 2).

The performance element of the app ensures endless creative possibilities but may frustrate those with a wish to edit the minutia of performances. With novices in mind, testing revealed the potential for immersion, user satisfaction and instant creativity.

Studio HD: SUS Score: 87.5/100

Studio HD follows the traditional DAW interface architecture with a ‘left-to-right time line’ approach but reduces advanced functionality to the bare minimum, keeping the interface clean and easy to navigate. The user is given three main windows, the loop browser, the multitrack timeline and the loop information window. In addition, a simple mixer with track volumes, mutes and special effects is neatly hidden on the left of the GUI as a pull out tab when required. The only gripe here was the lack of any pan controls. Using the app was simple. Users can drag loops from the browser onto the multitrack timeline and can create loop-based compositions in minutes. The app automatically time-stretches all loops to the project tempo. Users can also preview audio loops prior to adding to their composition by touching the loops in the loop browser. The app is instantly capable of previewing loops in layers and creating loop-based compositional sketches. The slight downside to this app is the clumsy export facilities if the user wishes to export to a more advanced composition in a full DAW. However, general usability testing revealed that user satisfaction, immersion and creativity were all highly rated for this app.

Conclusions

The *System Usability Scale* (SUS) (Brooke, 1996) scores indicate the subjective usability of the apps at two levels. First, at the individual usability question level and second the level of general usability. For educators who have specific classroom needs, the individual questions may be more pertinent. For example, if there is limited time to learn an app in the classroom, attention should be paid to the results of question 7 which asks about the speed of learning an app. Or, if available staff need technical support skills, the results of question 4 concerning technical support will be important. The level of user satisfaction, effectiveness and efficiency emerges from the general usability scores. These may be more important to educators who want a usability overview.

As this paper describes preliminary testing by the curriculum designer alone, further classroom testing with multiple students would offer a larger data set and improved validity.

The SUS is relatively fast and easy to administer, making it an ideal method for the testing of apps. The testing notes are added value, specific to the goals of this study. Because of the subjective nature of usability, testing notes will enhance the purely numerical SUS scores. Some have suggested that the use of Likert scales to assess usability has the potential to be misleading (Gardner & Martin, 2007) and one dimensional. After all, a comparative numerical score out of 100 could be construed as limited in scope to describe user satisfaction, effectiveness and efficiency. This study concludes that quite the opposite was the case, but only in conjunction with the subjective testing notes. There were factors specific to this study, which contributed to user satisfaction that emerged as themes during the testing period. These became more focused during the writing of the ethnographic testing notes as the author was required to articulate why these apps provided *satisfaction, effectiveness and efficiency*.

Factors specific to loop-based music app design

For loop-based composition *file management* emerged as a key factor. How effectively was the user able to manage and interact with the loops? Could they be previewed quickly and efficiently added to a composition? File managers like those in *Loopy HD* which hid the file manager behind a number of buttons slowed the process of composition. In contrast, *Studio HD* offered a file management system, as a main component of the main user interface; thus one of the reasons the app topped the usability scores.

The user's *prior experience* with music technology was also a factor that impacted the perception of satisfaction, effectiveness and efficiency because it set up the user's expectations. The more complex apps such *Cubasis*, may appear more usable to an experienced practitioner but unusable to a novice. The factor of the user's *prior experience* will be a variable within the classroom. It may be that effective use of *iPad* apps in the classroom may mean the deployment of a number of different apps.

Something that emerged from the testing was the divide between *performance-based* or *sequencing* loop-based composition apps. The performance-based apps tended to be DJ-centric and the sequencing apps music recording studio-centric. These do not cater to mutually exclusive user types but will impact any perceptions of usability. This factor of usability gestures at the user's *prior knowledge* discussed earlier, and similarly suggests that both types of app could be deployed in the classroom, certainly during any classroom testing research.

Immersion and creativity

Question 1 asks whether the user, "would like to use this system frequently". The responses to this question give a strong indication about the potential for immersion; however immersion refers to more than simply repetitive usage. Similarly for creativity, responses to question 9, around user confidence, may indicate a potential for creativity but no in-depth knowledge. The SUS individual question scores alone are of limited use in this regard. There are, however, definite synergies between app usability and creativity as argued in the earlier section on *creativity*. If apps are subjectively more *effective, efficient* and *satisfying* (Brooke, 2013, p. 32) to use, the higher SUS scores identify apps that are likely

to stimulate immersions and creativity. The additional qualitative testing notes offer some ethnographic description of user immersion and creativity from the single tester's perspective. This combination of SUS overall scores and qualitative reflection yielded the most useful results in this study.

Future research

In summary, the pilot testing of loop-based *iPad* apps demonstrated that the SUS methodology was an effective tool to determine general app usability. It also indicated comparative results of individual SUS questions across different apps where this data would be useful to educators. Another aspect of this study was to determine the potential of the testing methodology for future use in the classroom. The methodology was effective and would likely be appropriate in the classroom. Further classroom research involving multiple students would validate these preliminary testing conclusions and add more detail to questions around which apps were 'fit-for-purpose'. With regard to assessing whether immersion and creativity were being stimulated by specific apps, the SUS testing was strongly indicative. Future classroom studies would be wise to include additional questions to interrogate immersion and creativity, including user interviews or other psychometric research methods.

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Appendix 1

The System Usability Scale Scoring Format

The SUS uses the following response format:

Strongly Disagree 1	2	3	4	Strongly Agree 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Scoring SUS

1. For odd items: subtract one from the user response.
2. For even-numbered items: subtract the user responses from 5
3. This scales all values from 0 to 4 (with four being the most positive response).
4. Add up the converted responses for each user and multiply that total by 2.5. This converts the range of possible values from 0 to 100 instead of from 0 to 4 (Brooke, 1986)

Please cite as: Order, S. (2015). *ICreate: Preliminary usability testing of apps for the music technology classroom*. In *Teaching and learning uncapped. Proceedings of the 24th Annual Teaching Learning Forum*, 29-30 January 2015. Perth: The University of Western Australia. <http://ctl.curtin.edu.au/events/conferences/tlf/tlf2015/refereed/order.pdf>

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